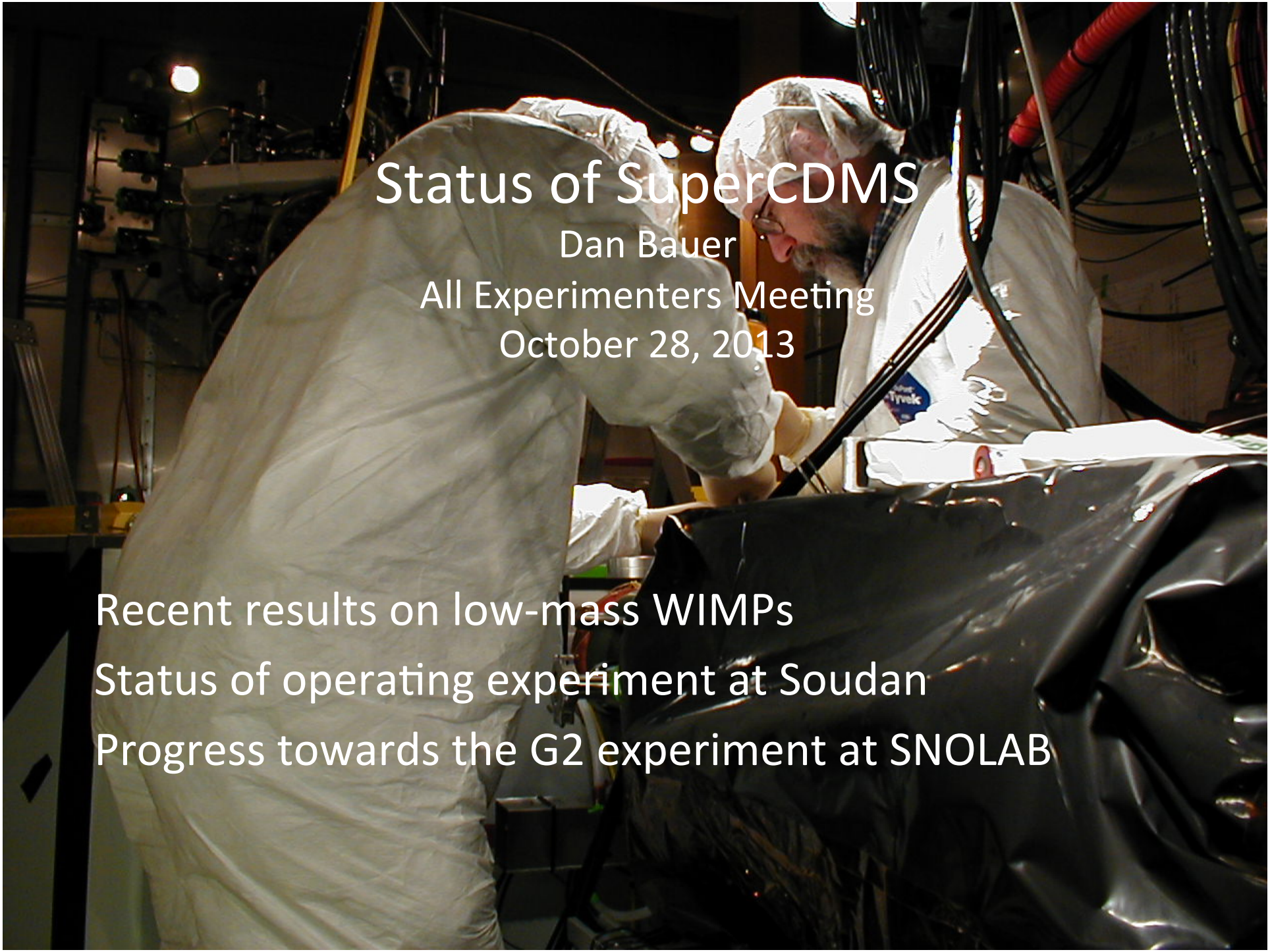


Status of SuperCDMS

Dan Bauer

All Experimenters Meeting

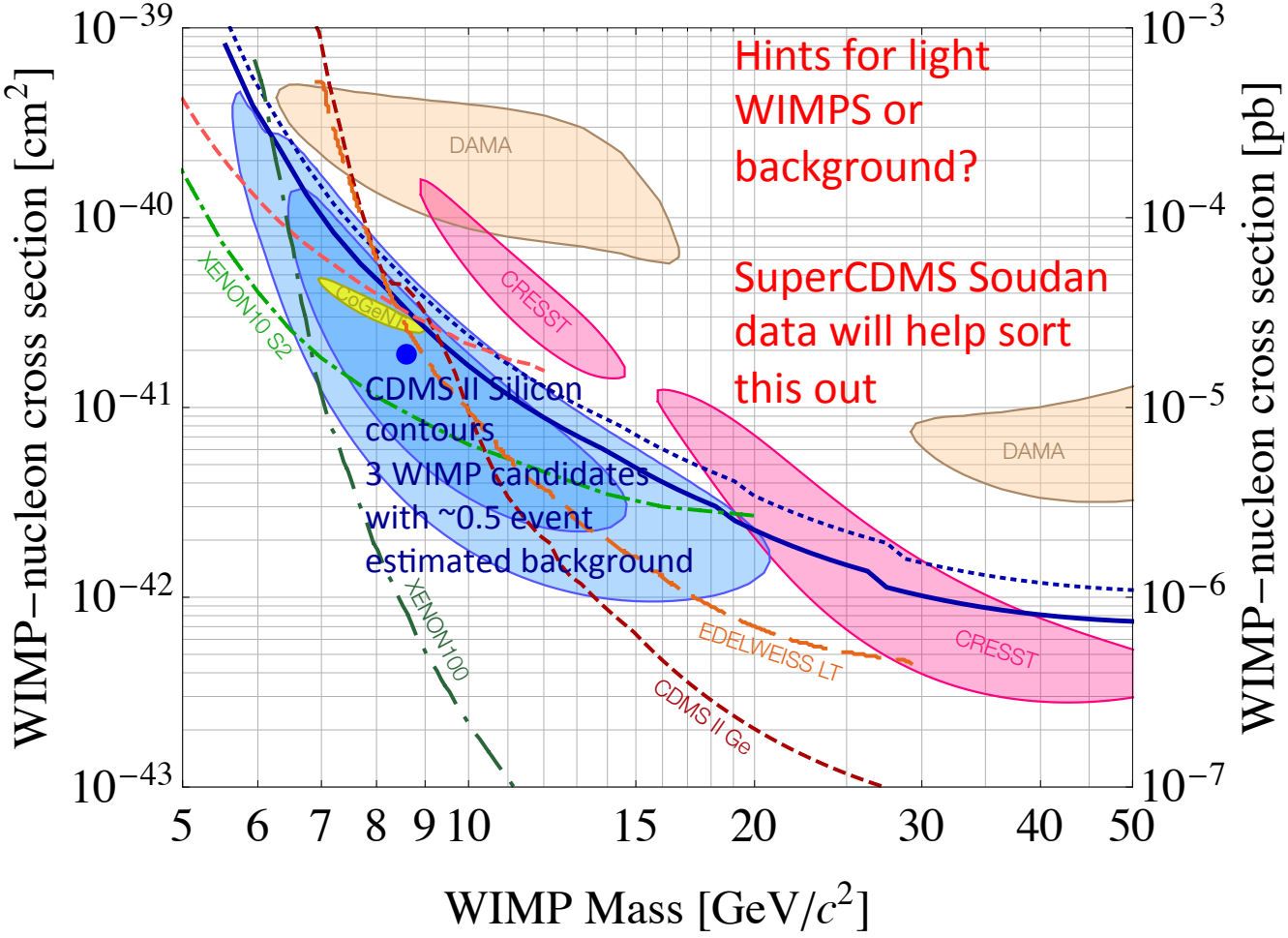
October 28, 2013

Recent results on low-mass WIMPs

Status of operating experiment at Soudan

Progress towards the G2 experiment at SNOLAB

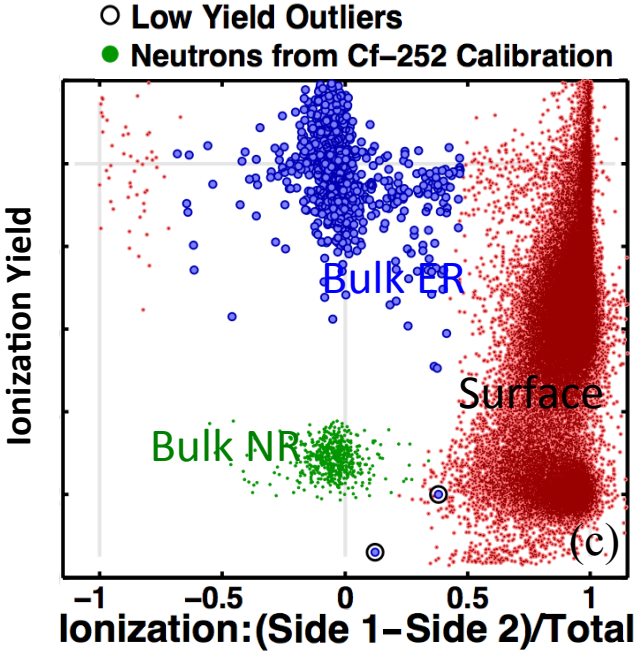
Recent Results on low-mass WIMPS: CDMS II Silicon

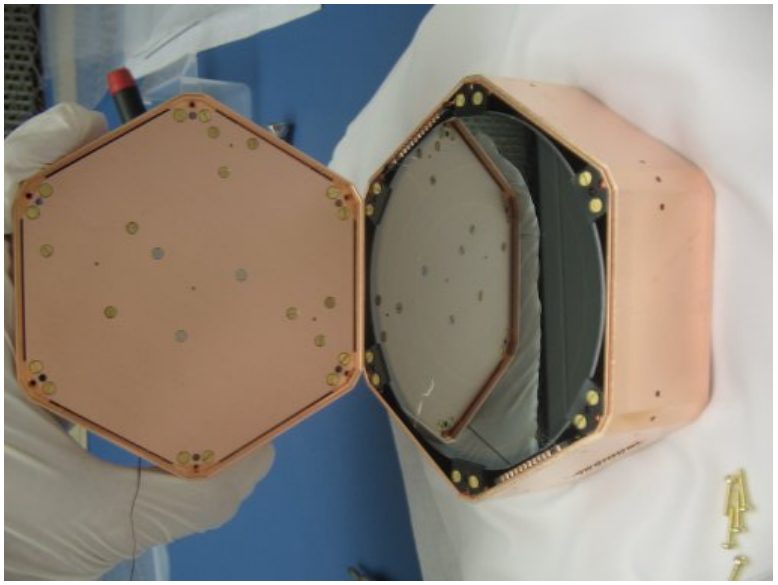


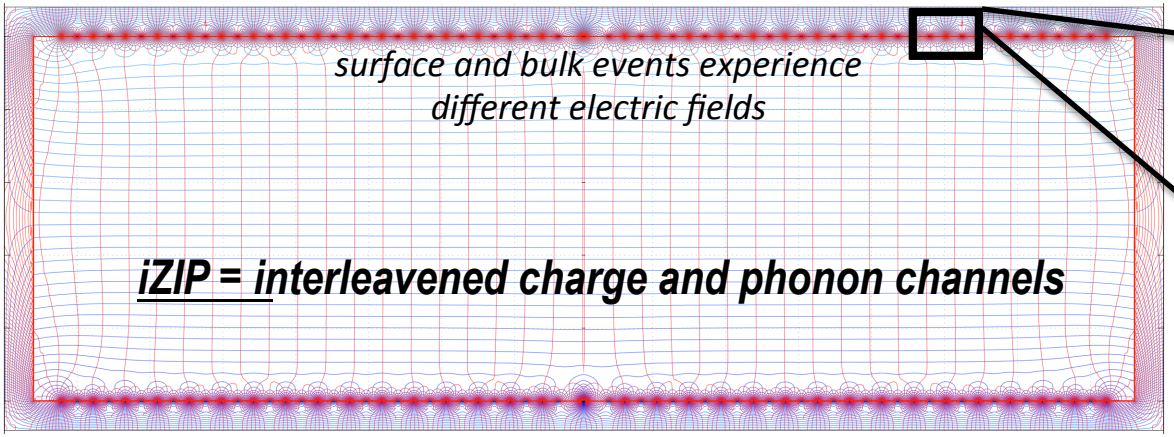
SuperCDMS Soudan

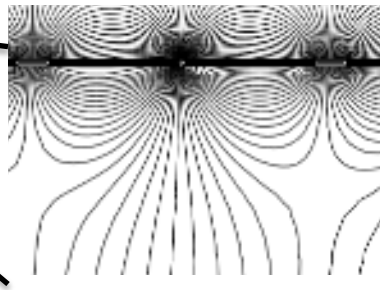
- Commissioned in fall 2011-spring 2012
- Operating since March 2012
  - ~2 years at cryogenic temperatures (~50 mK) in a remote location!
  - Expect to operate until March 2015
- Demonstrate iZIP background performance
  - ^{210}Pb sources supply surface events on 2 iZIPs
  - Paper on arXiv (http://arxiv.org/abs/1305.2405)
- Explore new low-mass WIMP territory
  - Check "hints" from CDMS II Silicon and other experiments
  - First CDMSlite result announced at TAUP2013 and on arXiv
  - First low-threshold iZIP result soon
  - Expect to test fully the CDMS II Silicon allowed region
- Higher-threshold, but background-free results in early 2014
  - Check Xenon100 results for higher mass WIMPs
- Explore new parameter space for axions, lightly-ionizing particles,…

SuperCDMS iZIPs – A Detector Breakthrough Against Surface Backgrounds





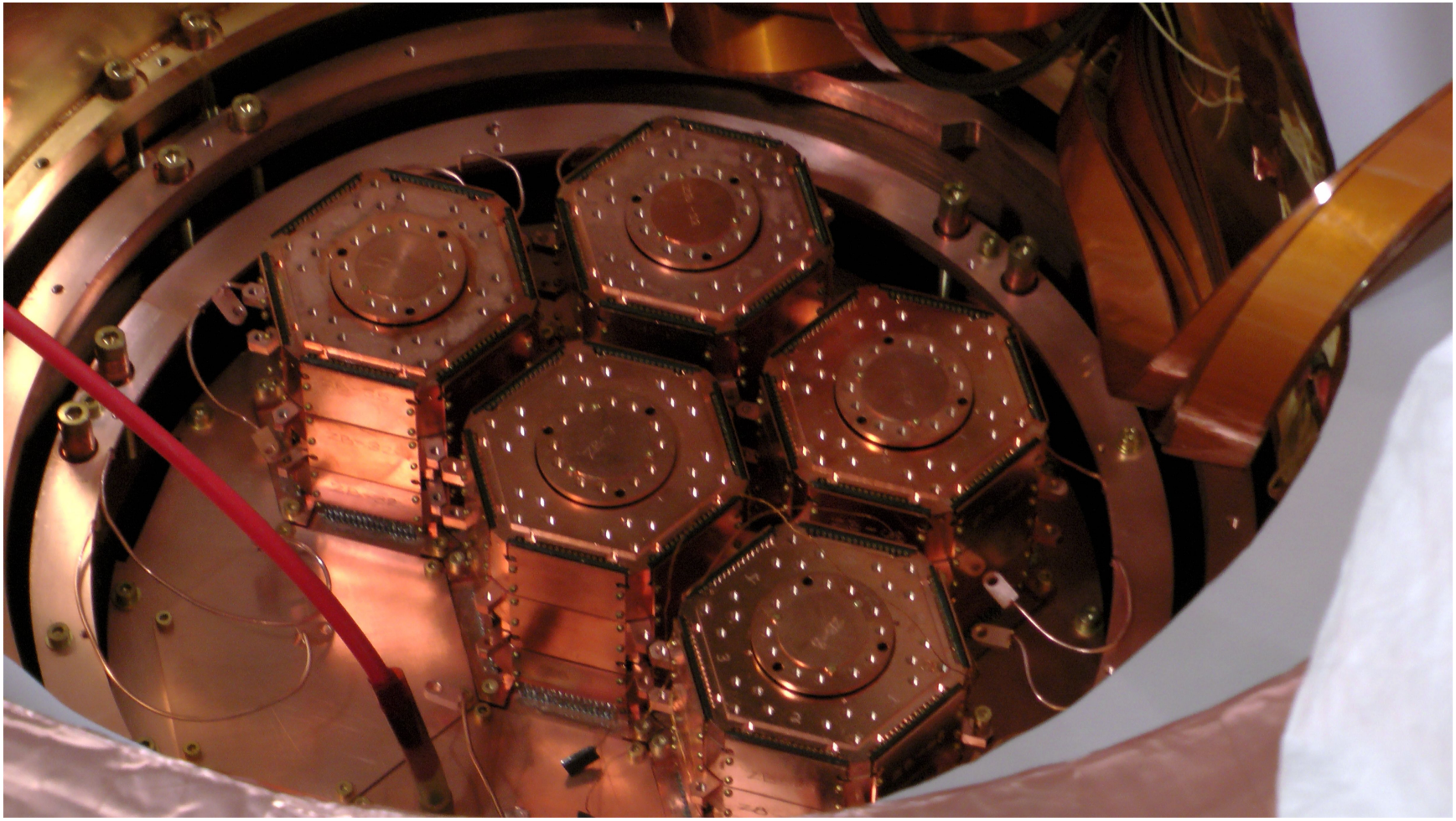




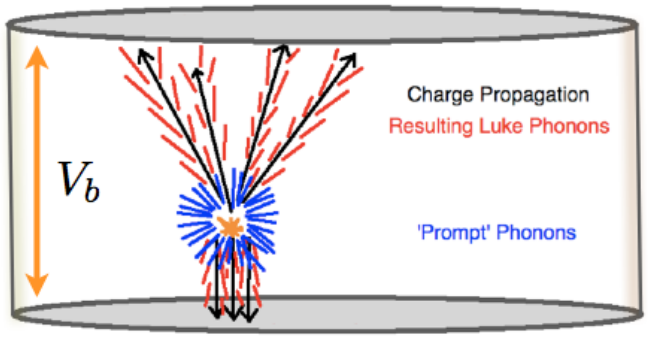
Charge near surface is collected by electrodes on only one side

iZIP Detectors at Soudan

15 Ge detectors, each 0.6 kg, arranged in 5 towers



Low Ionization Threshold Experiment: CDMSlite



First run at Soudan achieved energy threshold = 170 eVee!

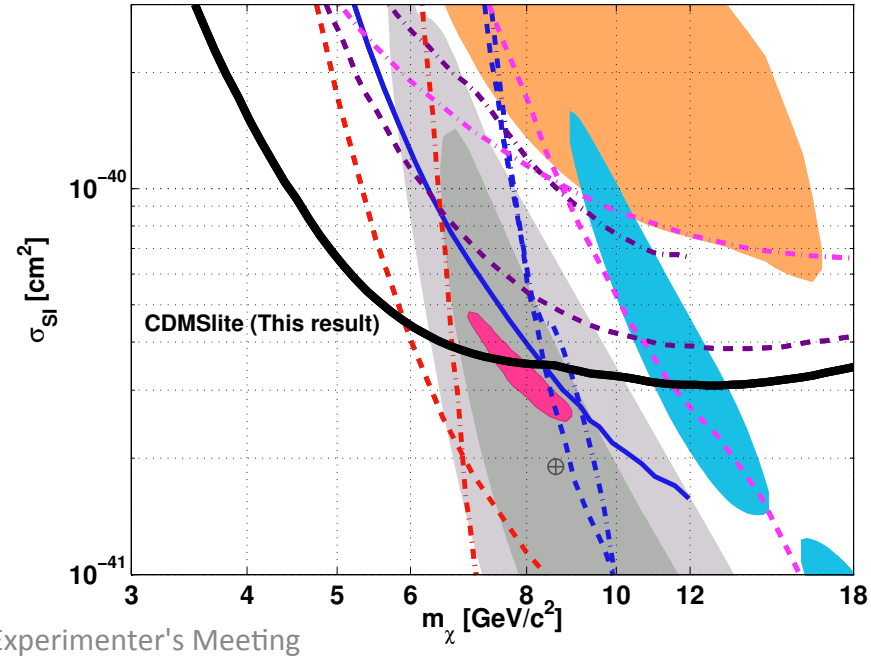
Consider all events as WIMP candidates (no background subtraction; sensitivity is background limited)

Plan a longer run soon to measure backgrounds and find ways to reduce or subtract

Apply larger potential across the crystal (69 V)

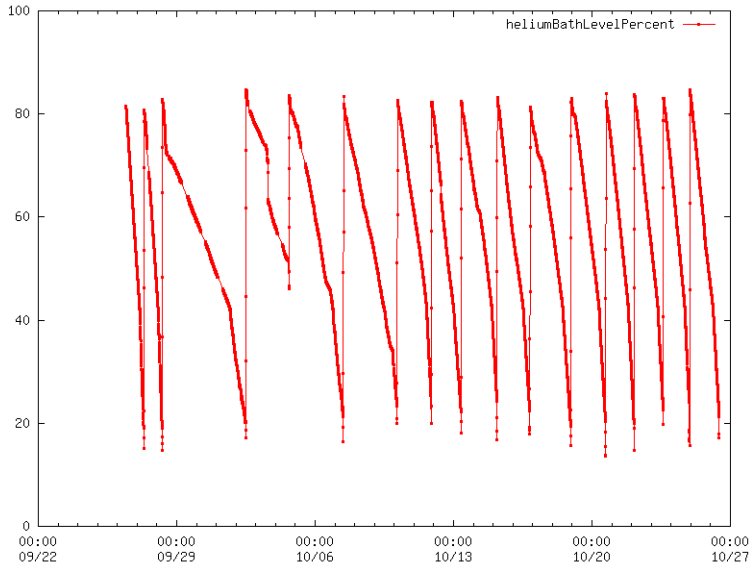
Collect much larger phonon signal without increase in noise (but lose most of the background discrimination provided by independent charge signal)

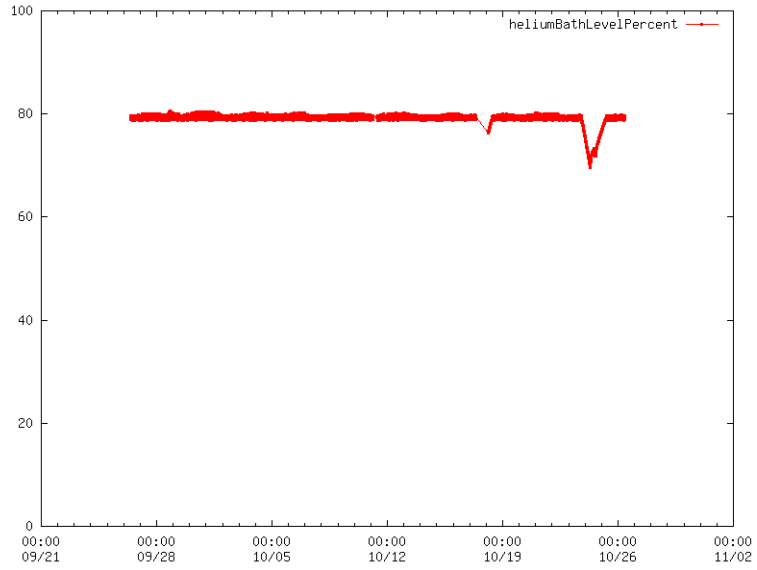
Goal is super low energy threshold, sensitivity to low-mass WIMPS



SuperCDMS Soudan Helium Recovery

- CDMS uses a dilution refrigerator for cooling
  - Required daily transfers of LHe and LN
  - Very expensive (~$250K/year) and time consuming
    - 1.5 hours/day with no data, ~16% of livetime
- Retrofitted a reliquefier system at Soudan
  - Based on 3 Cryomech two-stage LHe reliquefiers and 1 single stage LN reliquefier
  - Very limited space to fit this in; requires low-loss transfer line to return cryogens to dilution fridge
  - Rich Schmitt designed this and commissioned with Mark Ruschman and Soudan technical staff
  - It is now working and saves ~$600/day, as well as giving us 16% more livetime!





SuperCDMS Soudan Operations Issues

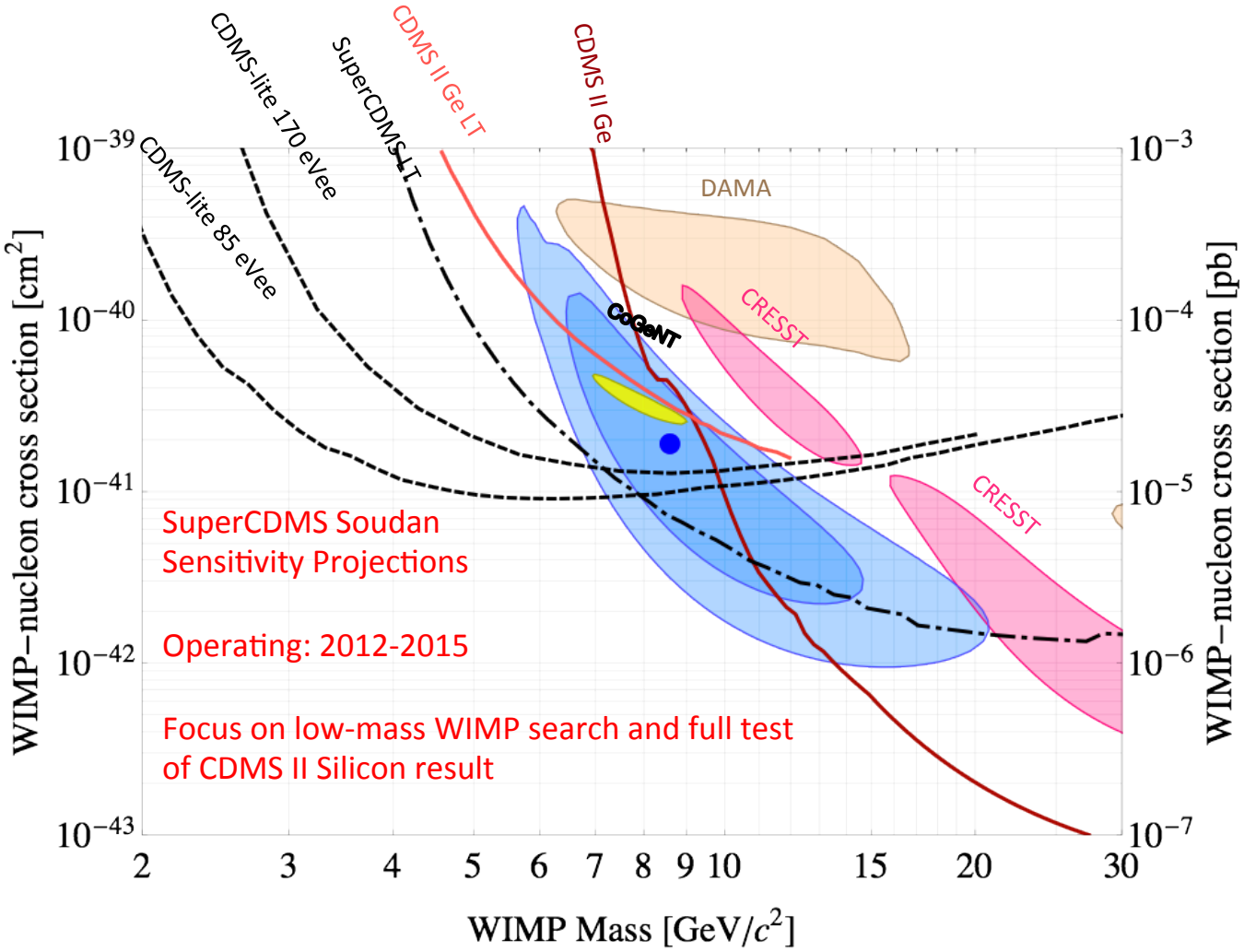
- Soudan infrastructure Issues
  - Relying on aging power feed in shaft
    - Working on better measurements of power usage
  - Vibrational “noise” seen in the detectors
    - Mainly from the cryocoolers
  - Outdated computing and networking
    - Keep patching it up for another couple of years
  - Cryogenics and electronics are 15 years old
    - Upgrading parts that fail and vigilant maintenance
- Soudan lab staff keep things running smoothly
- Remote monitoring and control are crucial
- Full UPS and diesel generator power backup also vital

SuperCDMS Soudan Operations Issues

- Experiment Issues
  - Failed detector channels
    - Several detectors have bad channels (cold shorts)
    - Source is believed to stem from quality control issues
    - Redundancy of charge/phonon channels means we can work around these issues in analysis
  - Low frequency noise
    - Combination of vibration sensitivity and 60 Hz harmonics
    - Have achieved 2 keV thresholds on enough detectors to do low threshold WIMP search
  - Occasional cryogenic issues
    - Small amounts of contamination can lead to partial blockages in dilution fridge (need frequent cold trap cleaning)
    - Small leaks in vacuum spaces require continuous pumping

SuperCDMS Soudan Sensitivity

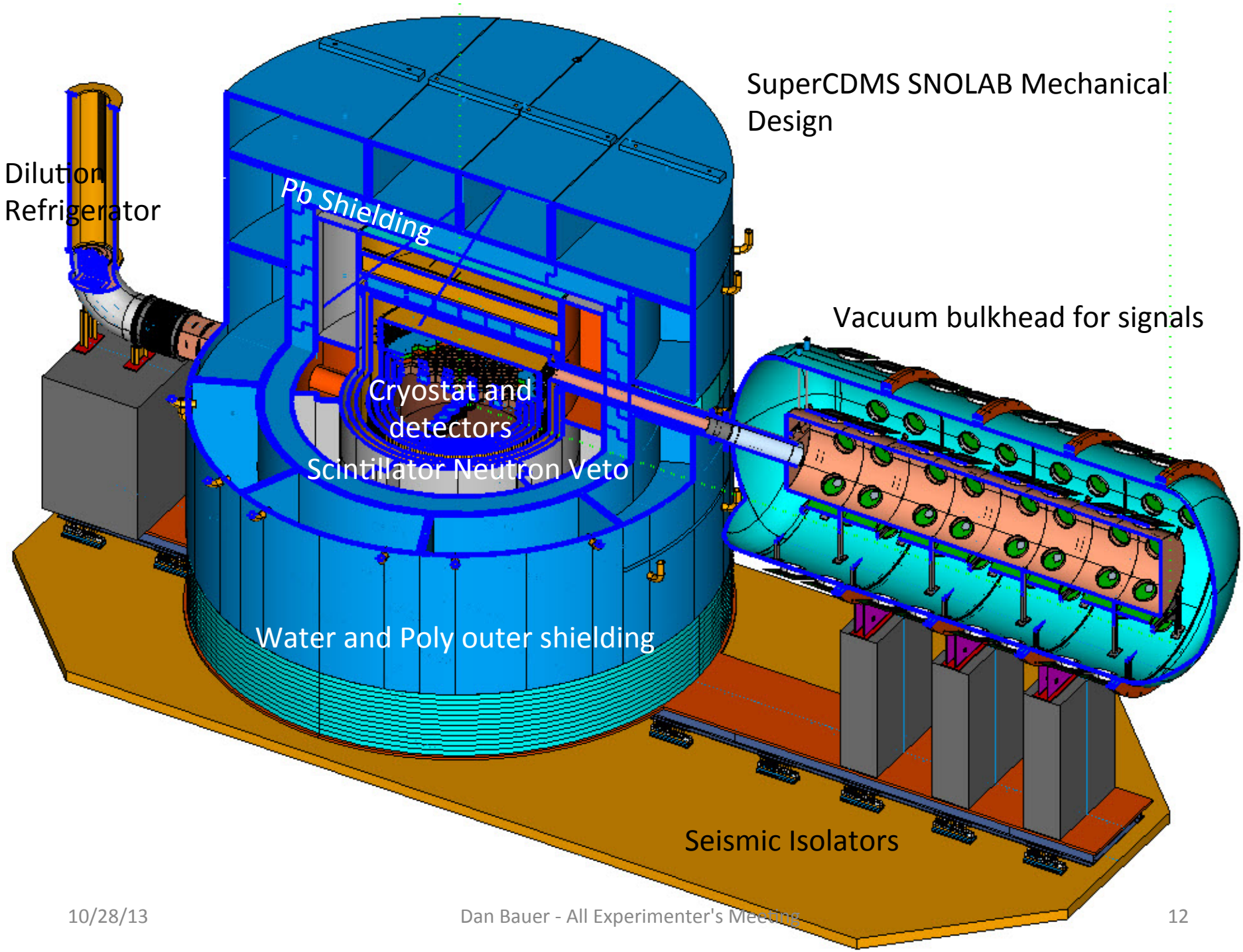
Currently have 372 live days; will double that by March 2015



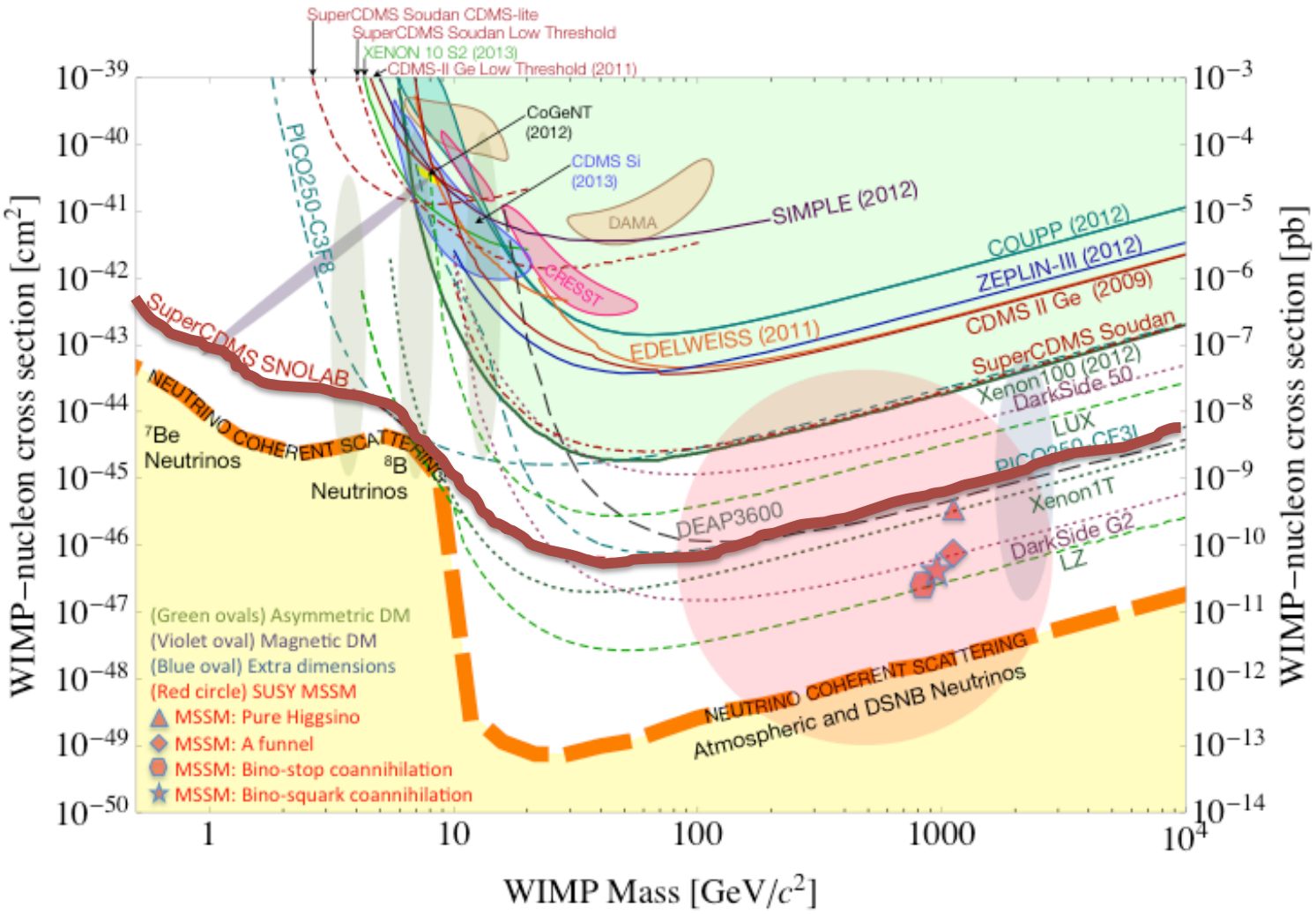
SuperCDMS SNOLAB (G2)

- Next-generation direct detection experiment with complementary reach for high-mass WIMPs and world-class low mass WIMP sensitivity
  - 200 kg Ge target mass composed of 100mm x 33mm iZIP detectors (also considering inclusion of Si detectors)
  - Cryogenics system designed for up to 400 kg of detectors at <40 mK (should achieve 20 mK)
  - Active neutron veto and passive shielding to achieve < 0.1 event background in 4 years of operation
  - Location at 6000 mwe depth in SNOLAB ladder lab
- Why go to SNOLAB instead of staying at Soudan?
  - X3 deeper, to avoid neutrons produced by cosmic rays
  - X10 cleaner, to avoid neutron backgrounds from residual radioactivity

SuperCDMS SNOLAB Mechanical Design



SuperCDMS SNOLAB Reach



Summary

- SuperCDMS Soudan is operating well
  - iZIPs demonstrate excellent control of backgrounds
  - First test of CDMSlite shows promising ultra low WIMP mass sensitivity
  - Low (high) mass WIMP results by late 2013 (early 2014)
  - Operate through March 2015 for final sensitivities
- SuperCDMS SNOLAB in full R&D
  - Expect to pass DOE "downselect in early 2014
  - CD design phase in 2014, fabrication in 2015-2016
  - 5 years of operation should allow exploration of low-mass WIMP region down to the neutrino floor